Technology News

Roads—Bridges —Transit —

Iowa Transportation Center

Iowa State University

August 1995

MoGO trainer shapes up roads in rural Russia

Alvin Jansen, a seven-year instructor in the Iowa Transportation Center's Motor Grader Operator workshops, and his wife Clariss returned July 9 from a three-week working trip to Russia, where Al built and reshaped some 20-plus miles of rural roads.

When Al Jansen retired from his 32-year career as motor grader operator in Crawford County, little did he dream that three years later he would be tapped to take his road-shaping expertise to Russia. But on June 20, Al and his wife Clariss left Iowa as volunteers in the Winrock International Farmer-to-Farmer Program to help farmers near St. Petersburg learn how to build and reshape their field-access and farm-to-market roads.

Winrock sponsored the Jansens' trip as part of the St. Petersburg Farm Privatization Project. The project is the result of an agreement between the U.S. Department of Agriculture and the Russian government. Through this program, the USDA provides technical assistance to 21 newly privatized farm families in one small area of Russia.

Two American farm families have been living there for two years to help local farmers (some of whom are ex-military personnel) meet the day-to-day challenges of private farming. Extension specialists and others, including volunteers like Jansen, visit regularly to contribute expertise and advice.

One of the biggest challenges faced by Russian farmers is the lack of adequate roads. Sometimes crops rot in the fields because farmers can't get to them with harvesting equipment. Sometimes farmers can't get their harvested crops to market.

For his work on Russian roads, Al Jansen used a motor grader powered by a Siberian-manufactured, 380-hp motor similar to motors used in Russian submarines, he says.

"You can't believe the shape those roads are in unless you see them yourself," Al says. "They're 70 years behind us in terms of knowing how to build and maintain unpaved roads." Al saw ruts that were 30 inches deep and four feet across. Some roads were impassable.

Al rolled up his sleeves and went to work. Coaxing high performance out of awkward equipment (his nonarticulated grader had a 13-foot moldboard and no hydraulic steering or scarifier), he reshaped existing roads on rainy days and built new roads on dry days.

On his last day in Russia, Al taught a seminar to eight farmers regarding building and maintaining dirt and sand-surfaced roads. Without a mechanism like our own county system to provide rural road services, the only way to improve the rural road system is for the farmers to learn to do it themselves.

continued on page 2

Inside

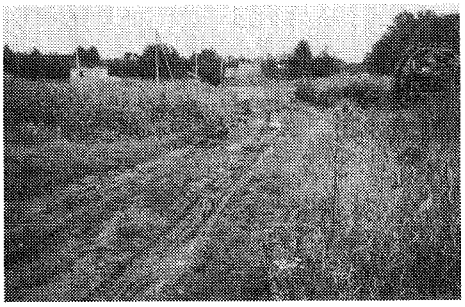
MoGO in Russia

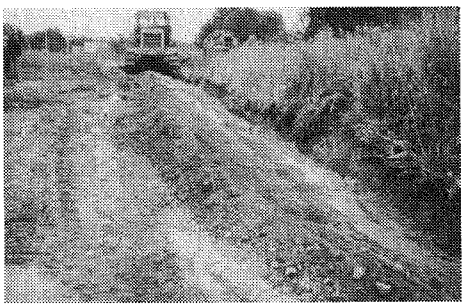
continued from page 1

"The people were terrific," he says. "They saw how roads could be improved, and they really wanted to learn how to make and keep the roads passable."

What about the language barrier? "Most of the time I had an interpreter. But, you know, even if you don't speak the same language, you can find ways to communicate. Although once at the local store I did almost buy four *dozen* eggs when I only wanted four!"

It was a once-in-a-lifetime experience—or maybe twice in a lifetime, as Al has already been asked to return next summer if funds are available. ■





Above, a typical muddy, rutted road in rural Russia near St. Petersburg. Below, Alvin Jansen widens the road and builds the crown.

Link found between magnesium and deteriorating concrete

An Iowa State University study indicates that magnesium from any source—including magnesium road deicers—may have a major role in the shortened service life of some highway concretes.

This article is adapted from The Role of Magnesium in Concrete Deterioration: Final Report, *by Robert D. Cody, Paul G. Spry, Anita M. Cody, and Guo-Liang Gan, Iowa DOT HR-355, November 1994.*

Most premature failure of concrete in highways is due to D-cracking—the deterioration of joints and cracks—and most D-cracking in Iowa results from freeze-thaw failure in the concrete's coarse aggregate. For several years, Iowa specifications for coarse aggregate in concrete have effectively eliminated those aggregates that are especially susceptible to freeze-thaw failure (clay or clay-like materials and materials with a high pore index), and the durability of new concrete roadways has improved significantly.

Still, a few concrete roads continue to fail long before they should. To understand why, a recent Iowa State University study compares concretes having service lives of less than 12 years (nondurable concretes) with concretes having service lives of 40 years or more (durable concretes). By examining the tell-tale results of chemical reactions in nondurable concretes, researchers are discovering clues to the possible causes of premature concrete failure.

One kind of chemical reaction involves concretes containing certain types of course dolomite aggregate. Researchers examined 4-inch cores from two durable concretes and five nondurable concretes from various parts of Iowa. All contain course dolomite aggregate from a variety of Iowa quarries and geologic formations, but the characteristics of the aggregate in nondurable concretes differ significantly from those of the aggregate in durable concretes. Using an electron microscope and a petrographic miscroscope, researchers discovered that the dolomite aggregate in nondurable concretes is generally fine-grained, with abundant void spaces between poorly formed dolomite crystals. The dolomite aggregate in durable concretes is coarse-grained, with large, extremely well crystallized and tightly intergrown dolomite crystals and low porosity.

In addition to differences in characteristics of the dolomite aggregate in durable and nondurable concretes, the cement pastes in both concretes show major textural differences. Nondurable concretes exhibit significant evidence of chemical reactions—reaction rims—along the interface between the dolomite aggregate and the cement. Durable concretes show few apparent reaction rims in either the dolomite or the cement paste.

Using an electron microprobe and a scanning electron microscope (SEM) for back-scattered electron imaging and elemental mapping, researchers zeroed in on the reaction rims in nondurable

continued on page 3

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The opinions, findings, or recommendations expressed here are those of the Iowa Transportation Center and do not necessarily reflect the views of the Federal Highway Administration or the Iowa Department of Transportation.

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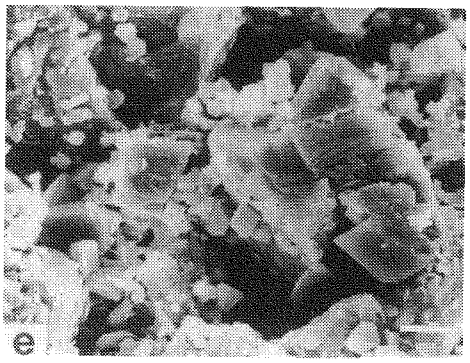
Magnesium and deteriorating concrete

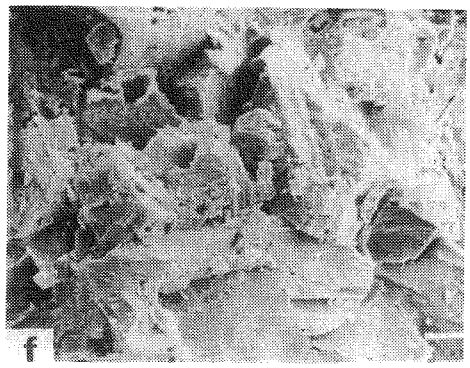
continued from page 2

concretes. The rims studied result from chemical reactions between the concrete paste and the dolomite ($CaMg(CO_3)_2$), a process called dedolomitization. Researchers conclude that the highly alkaline portland cement reacts with certain types of dolomite aggregate—those consisting of poorly formed, fine-grained dolomite crystals without a strongly interlocking crystal fabric.

The alkali-dolomite reaction is the ultimate cause of concrete deterioration in the concretes studied, but the reaction itself does not produce the deterioration. Dedolomitization, or partial dedolomitization, produces environmental changes in the concrete itself that damage it.

Researchers believe that in the dedolomitization process, dolomite in the aggregate reacts with hydroxide in the cement to free magnesium ions and carbonate ions. The magnesium ions migrate into the cement, reducing the magnesium along the interface between the aggregate and the cement and, most important, reacting with the cement and precipitating brucite crystals ($Mg(OH)_2$). Simultaneously with the dolomite/hydroxide reaction, product carbonate ions react with portlandite from the cement to form calcite crystals and hydroxide ions.





SEM micrograph of aggregate in nondurable concrete (top) shows fine, highly porous, poorly formed dolomite crystals. Micrograph of the aggregate in durable concrete (bottom) shows large, tightly intergrown, well formed dolomite crystals.

Ultimately, researchers conclude, the formation of brucite and, to a lesser extent, calcite crystals causes growth pressures that lead to volume expansion, weakening the aggregate-paste bond and causing micro-cracking in the concrete.

A direct cause of rapid deterioration of nondurable concretes, then, is the release of magnesium at the interface of the aggregate and cement paste and the subsequent interaction of the magnesium with the cement paste to cause crystal growth.

If magnesium/cement reactions within concretes weaken roadways, what happens when magnesium is applied to the surface of concrete roads? In particular, what are the effects of magnesium-rich deicing solutions on concrete?

To answer these questions, researchers soaked both durable and nondurable concretes in magnesium chloride. As bases for comparison, additional concretes were soaked in calcium chloride, salt solutions, and plain water. One set of experiments involved continuous immersion of the concretes; another involved cycling between total immersion and complete drying, at two different temperatures; and a third involved cycling between total immersion and freezing. A few experiments substituted magnesium acetate and magnesium nitrate for the magnesium chloride.

Of all the treatments, concrete deterioration was especially severe with the magnesium chloride. When treated with magnesium chloride, both durable and nondurable concretes equally experienced cracking of both the paste and the aggregate. Magnesium acetate and magnesium nitrate produced similar results.

Calcium chloride produced similar, but less intense, concrete deterioration. In contrast, salt solutions were nearly nondestructive to the concrete.

The results of these tests are significant: Magnesium and calcium deicers may produce more damage to highway concrete than do the widely used sodium chloride deicers.

In sum, the addition of magnesium to concrete—whether from the dedolomitization process within or from chemical deicers on the surface—appears to be deleterious to the concrete.

Researchers are following this study with additional research into factors affecting the reactivity of dolomite aggregate. They will test procedures for increasing concrete service life, like blending dolomite and limestone aggregate, or using low-Mg cement, to reduce deterioration related to dedolomitization of reactive dolomite aggregate. These procedures may reduce the potentially negative effects of magnesium chemical deicers on concrete roads.

For more information, contact Robert Cody or Paul Spry, Department of Geological and Atmospheric Sciences, Iowa State University, 515/294-1714 or 515/294-9637, respectively. ■

ITCSA to celebrate 20th anniversary

Past presidents will be honored guests at this year's Iowa Traffic Control Safety Association's conference, coming to Carroll on September 14 and 15, 1995.

Speakers will discuss the latest in traffic safety research, preventing accidents involving deer, traffic enforcement's paybacks, safety management systems, getting your share of traffic safety funds, and more.

A barbecue the first evening will be the setting for the association's 20-year anniversary celebration.

For registration information, contact Connie Middleton, 515/294-6229. ■

GIS/GPS implementation issues: part one

This two-part series provides an initial review of GIS/GPS implementation issues. It is adapted from an article in the May issue of *Coordinated GIS*, the newsletter of the Iowa Geographic Information Council.

Every day more agencies, companies, and individuals are using or are considering using geographic information system (GIS) and global positioning system (GPS) technologies. This article is an informal discussion of some implementation issues that may interest Iowans who are facing these decisions. It is by no means comprehensive and, of course, the opinions are my own.

To provide a common reference and starting point, we can define GIS as a collection of software, hardware, data, trained personnel, and repeatable procedures used to store, manage, analyze, and graphically present geographically referenced data. GIS is used to support decision making.

GIS implementation issues include the following:

- hardware and software
- staffing and training requirements
- application areas
- reference systems
- real-time GIS
- provision of low-cost, accessible GIS
- the impact of governmental and business reorganization/rightsizing and increased reporting requirements (funded and especially unfunded mandates)
- standards
- cost of public sector providing data to interested individuals or private firms
- relationship with vendors

"Data capture" is not on the above list; we'll use that concept to move to GPS.

GPS is a collection of components (satellites, ground stations, mobile receivers, and base stations) that together provide a relatively low-cost, accessible method for capturing geographic coordinate information for points. Using small, portable receivers, folks can obtain coordinates for specific points or sets of points to define lines (e.g., roads) and areas (e.g., parcel boundaries).

Microtechnology

by Reg Souleyrette
Associate Director for Research

GPS implementation issues include the following:

- type and cost of available hardware
- time and effort required to collect data
- accuracy

In this part one, GIS implementation issues are discussed. Part two, in the October newsletter, will discuss GPS implementation issues.

GIS Issues

Hardware and software. Mention GIS and many people think hardware and software. Although they are but two of the components of a GIS, they remain central, important considerations. Direct cost is the first limiting factor for small organizations. Larger agencies can consider indirect costs that may result from the improper selection of hardware and software and therefore may buy into more expensive, more fully functional platforms early on.

Direct costs range from about $6,000 for a low-end system or work suite (PC, software, and plotter) to around $50,000 or more per work suite for high-end systems. There are returns to scale in hardware/software as smaller organizations realize benefits of sharing peripherals and licenses and larger organizations are able to command volume discounts.

Staffing and training requirements. A significant cost of GIS development, especially for very small organizations, is for staffing and training. Choice of software and hardware greatly impacts cost and training/start-up time. Some desktop mapping and low-end GIS software may be installed and used the same day (with existing or demo datasets). Other packages require months of training and trial and error before users become proficient (although these packages are generally much more flexible and powerful).

Training can be provided at vendor locations, in house by vendors, and in house by trained staff. Training costs should not be overlooked when estimating the cost of GIS development. Larger organizations face many institutional issues when developing GIS and usually require a full-time GIS coordinator to get the ball rolling and overcome initial resistance to change.

Coordinators require significant technical and managerial expertise, as well as perception and a vast knowledge of the organization's business practices and trends. Recruiting and retaining a coordinator with all these skills can be a challenge.

Application areas. GIS can be applied in too many disciplines to be listed here. For example, areas have included transportation, emergency management, agriculture, health fields, soil conservation and natural resources, forest resources, environmental research and ecological assessment, demographic analysis of user-defined geographic areas, and base mapping.

It is important for an organization to be able to effectively visualize the capabilities and applicability of GIS before embarking on development. As an example, the Iowa Department of Transportation systematically identified over 400 potential applications for GIS within the department. Some of these applications include

- accessing and storing data on pavement analysis and design
- determining and displaying the condition of pavement by location
- producing detour maps
- accessing sign and post locations and data
- storing and accessing bridge deck conditions
- accessing and identifying crack and patch paving locations
- producing plans for traffic control in work zones

continued on page 5

GIS/GPS

continued from page 4

- transferring data from the Department of Natural Resources, the Federal Highway Administration, cities, and counties
- providing information on property ownership for the signing of documents authorizing legal right of entry on private property to perform surveys and soil investigations
- exchanging information with other offices regarding recommended design changes, borrow areas, access, and the effect of proposed right-of-way projects

While not all of these applications may be feasible, the exercise provided them with a basis for understanding how GIS could be used within the organization.

Reference systems. For small organizations, the reference systems issue is overlaying data from various sources in a common framework. The sophistication of software dictates its capability to transform datasets from one coordinate system to another. The key is the use of "real-world" coordinate systems such as geographic coordinates, state-plane, or UTM (among many others). Local reference systems (such as local XY) or maps digitized from sources without coordinate systems may represent difficult reference problems.

At large organizations—particularly transportation, utility, and emergency management departments—reference systems are key issues. The nature of the data maintained and used by these departments varies (linear for transportation, address (point) data for emergency response (911, etc.). There are many legacy reference systems (e.g., mileposts for transportation). Reference systems must allow field personnel to find locations quickly (911), economically (roadside maintenance), and accurately (911, accident locations, etc.).

Recently, federal legislation (the Intermodal Surface Transportation Efficiency Act of 1991—ISTEA) has mandated the development of several infrastructure management systems at transportation departments. This legislation also mandates the coordination of databases used by these systems. Common referencing, or at least an effective method of cross-referencing, is a must. Many 911 systems are being redefined and improved. Unfortunately, it is unlikely that many of these organizations are effectively coordinating the design of new reference systems. GIS provides many tools useful for improving referencing.

Real-time GIS. Traditionally (if that term applies to a relatively new technology), GIS has been used to store, analyze, and present "static" databases. That is, information is collected, sometimes over a period of time, and once complete, comprises THE DATABASE. Many applications, however, require that information be updated practically as it changes. Examples include 911, truck routing (bridge clearances during roadway construction), and emergency management (roads still open during flood events).

Low-cost, accessible GIS. Early development of GIS applications tended to be on high-end platforms at large institutions. A concern is that production-environment applications need to be user friendly, and on platforms that allow the widest possible accessibility.

Several GIS software packages provide a range of tools to help accomplish this objective. These include ArcView II for ESRI's ArcInfo, and VistaMap for Intergraph's MGE. Several other lower cost GISs also can be used in conjunction with more complex environments. (MapInfo comes to mind, as it has translators for ArcInfo (ArcLink) and data can be exported to MGE also.) It is possible, however, to develop applications that would require continued use of the full-function platforms (e.g., applications requiring dynamic segmentation capabilities). Consequently, care should be taken with regard to this in applications design.

The impact of governmental and business reorganization/rightsizing and increased reporting requirements (funded and especially unfunded mandates). At many agencies and companies, reorganization and downsizing have required fewer staff to do more with less funding. Also, an increasing number of legislative actions mandate the collection, use, and dissemination of information (e.g., ISTEA). GIS is considered to be a technology to help organizations deal more effectively with information and reporting requirements.

Standards. Even though GIS is a tool and is independent from decisions on scale and accuracy, many early discussions about GIS implementation center on standards. While debate continues regarding the level of accuracy to which data should be collected, consensus seems to exist that information should always be provided that allows good documentation of data (metadata).

A national standard for data is being developed (National Spatial Data Standard—NSDS), as well as a guideline for what should comprise metadata (Content Standard for Digital Spatial Metadata). Many organizations have concluded that development of a good data "dictionary" is a must, and good documentation of applications is also very important for quality control. Remember: GIS does not improve the quality of existing data, and GIGO (garbage-in-garbage-out) applies. GPS-level accuracy may be forming a defacto standard for many GISs' accuracy (see the section on accuracy discussed under GPS issues later in part two).

Cost of public sector providing data to interested individuals or private firms. Many private and governmental organizations are discovering that data being collected and maintained in public sector (and utility) GISs could be very useful to their projects. Examples include location of businesses, environmental impact studies, marketing, etc.

Freedom of information is a principle with far-reaching implications in the world of GIS. Several agencies have taken a proactive approach to this potential "problem" by providing their GIS and other data on-line via the Internet (e.g., the Iowa DNR, U.S. Geological Survey, and others). Others maintain data distribution policies that facilitate effective data sharing (Iowa DOT, others).

Relationship with vendors. The advantages of a close relationship with a particular GIS software/hardware/vendor are clear. Simply put, vendors are likely

continued on page 6

GIS *continued from page 5*

to know the most about the products they deliver. Often the best training and consulting are available directly from the vendor. The vendors are very professional and try to be objective as they suggest solutions to clients' problems, as most vendors count on repeat customers.

However, GIS applications development has at least one important characteristic—that is, the way a particular problem is approached depends on the tools available in the particular software package being used. Having used three GIS packages, I have to admit there are certain packages I prefer for certain features. In fact, development time for GIS applications can easily double or triple if the wrong package is chosen.

Choosing the right package, however, depends on more than the capabilities of the software; it also depends on the abilities and experiences of the analyst. Vendors continually strive to make sure their users are aware of the particular features of their software, but it is impossible for users to know everything about each package. The relationship between a vendor and an organization (particularly a large one) is a subject that requires special attention so that the resource can best be used without compromising objectivity.

Corrections and suggestions are welcome. Contact Reg Souleyrette, 515/294-8103; e-mail: reg@iastate.edu.

Next issue: GPS implementation issues ■

City of West Des Moines uses GIS

GIS is reinventing local government, says John P. Wilson, professor of geography at Montana State University, in *Public Works* (May 1995). Emphasizing that "geography is important to 80 percent or more of the information managed and utilized by local governments," Wilson believes GIS is a valuable tool to help local governments use geographically referenced information as the basis for sound planning and decision making.

One local government being reinvented is the City of West Des Moines. The city is digitizing its maps, with the goal of eventually connecting these maps with different kinds of data to create sophisticated traffic planning and engineering tools.

The digitized maps fall into two categories: those representing the physical infrastructure (e.g., streets, bridges, traffic control devices, etc.) and those that visually represent the city traffic code (e.g., parking designations, speed zones, etc.).

From these different layers of maps, special maps can be created that show only certain information like

- through streets
- streets with particular traffic control devices (e.g., intersections with four-way stops)
- safe school routes for a particular school
- all traffic signals

The potential uses for this mapping system are endless. One eventual GIS application will be to perform risk analyses of designated safe school routes. By correlating existing routes with data like traffic volumes and type of traffic (for example, truck versus automobile), planners can evaluate and, if necessary, redesignate the safe school routes.

Another application involves power outages. Cooperating with the electric utility, the City of West Des Moines can overlay the utility's power grids on a map of the city's traffic signals. During a power outage, city traffic engineers can see at a glance which traffic signals are affected—including signals *outside* the affected grid that are coordinated with signals within the grid.

Don Callender, traffic engineer for West Des Moines, says the process of digitizing the maps has been time consuming (they've been working on the project for more than three years as time permits), and he has been frustrated by the lack of accessibility to pre-existing databases (e.g., traffic databases).

"It's a lot easier to edit an existing database for your own needs than to reinvent the wheel," Callender says. "We know these databases are out there, and we'd like to be able to benefit from others' experiences, to see what kind of data other cities are tracking."

In spite of the implementation challenges, Callender is excited about the potential for GIS to help his department plan safer, more efficient traffic patterns and respond more quickly to emergency situations. "GIS is the wave of the future in traffic engineering," he says. ■

First Iowa GIS conference coming in November!

The scope of GIS activity in Iowa, along with a vision for the future, will be highlighted at Iowa's first GIS conference November 7 and 8, 1995.

Session speakers will discuss a variety of topics, including:

- information on GIS technologies
- special considerations involved in communications
- large-scale basemapping
- emergency management systems
- transportation
- mapping Iowa's bio-landscape
- getting started—for anyone considering the leap into GIS

Hosted by the University of Iowa's Department of Natural Resources, Center for Global and Regional Environmental Research, and Iowa Social Science Institute, the conference is also sponsored by the Iowa Transportation Center and the Iowa Geographic Information Council.

For more information and/or a registration form, contact Reg Souleyrette, 515/294-8103; e-mail: reg@iastate.edu; or Joyce Baker, 515/319/335-2070; e-mail: joyce-baker@uiowa.edu. ■

Iowa DOT reorganization: spotlight on Project Development Division

Once a project concept has been approved for the state's five-year transportation plan, actual plan development becomes the responsibility of the Project Development Division. The division includes pre-contract offices which, for each project, design a constructable facility, acquire needed right of way, negotiate external agreements, develop a set of bidding documents, advertise for bids, hold the letting, and award a contract for construction. The division is also responsible for post-contract activities. In this phase, offices within the division administer and inspect construction activities, test and approve materials used in the construction project, and sell or manage any excess right of way.

As Tom Cackler, director of the Project Development Division, told Iowa Department of Transportation employees, the division had two major goals in mind when reorganization began:

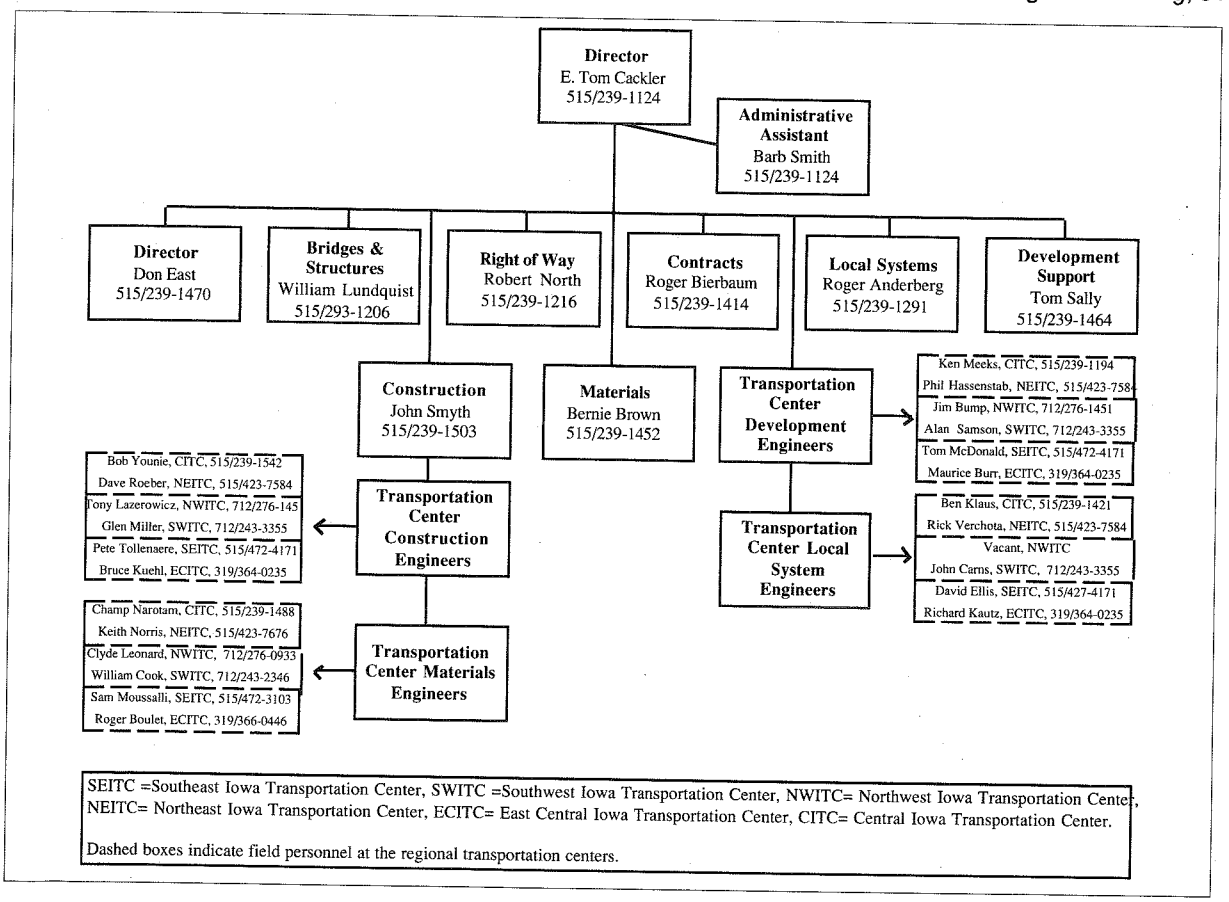
- Become more customer focused.
- Ensure development processes are handled as efficiently as possible in a team environment.

As a result of reorganization, the Office of Development Support was established within the division to centralize and consolidate several functions from the former Highway Division. By centralizing these functions, the division brought support resources together to enhance its mission. Sections within the Office of Development Support include Specifications, Environment, Project Agreements (city, county, state, and railroad), Resource Evaluation, Automation Productivity, and Value Engineering.

The division's Office of Local Systems works as an advisor for local officials who will be affected by or involved with programs that provide funding to local authorities. Roger Anderberg, director, Office of Local Systems, says the office interprets federal and state regulations and helps local authorities develop a project that complies with those regulations. The office then reviews a prospective project and helps local agencies who are involved in the project understand how to qualify for federal and/or state aid. As a result of reorganization, the Office of Local Systems has become multimodal and is able to consult with local agencies regarding projects for various modes of transportation.

The Iowa DOT's reorganization theme places greater emphasis on customer relations. One change implementing that theme was to designate a development engineer at each Transportation Center. This engineer acts as a liaison between the Project Development Division and local agencies when the Iowa DOT is considering and developing plans which impact the local agencies' transportation facilities.

For more information about development support, contact Tom Sally, 515/239-1464; for local systems, contact Roger Anderberg, 515/239-1291. ■



With reorganization, the Iowa Department of Transportation's Project Development Division established the Office of Development Support, dramatically restructured the Office of Local Systems, and assigned development engineers to the regional transportation centers.

Get ready for . . .

Which deicing chemical should you use?

By April Greenbeck, Editorial Assistant

Choosing the right deicing chemical is extremely important, but can be challenging since certain chemicals may work better in certain situations. When choosing a deicing chemical, you should consider the cost and effectiveness of the product, along with any possible environmental concerns surrounding the product. This article and the accompanying table summarize these and other considerations.

Deicing is the practice of applying a chemical to snow, ice, or frost that has bonded to the pavement surface. The chemical breaks the bond, allowing for easy removal of ice and snow, making travel much safer and easier.

The deicing substance most commonly used in Iowa is sodium chloride, also known as rock salt. Due to its low cost and easy accessibility, sodium chloride remains the most commonly used deicing chemical in the country despite possible environmental concerns, its corrosive properties, and the development of other chemicals.

Environmental concerns about rock salt hinge on the loss of salt pellets when they bounce off the road and into the ditch as they leave the spreader or are pushed off the road by traffic. Problems can also arise when salt enters the environment in the slush and melting snow, or from runoff in the storage area. The waste of large quantities of salt is potentially harmful to the envi-

continued on page 9

Characteristics of common deicing chemicals

COMMON DEICING CHEMICALS	Sodium Chloride (rock salt) $NaCl_2$	Calcium Magnesium Acetate (CMA) $CA(O_2CCH_3)_2 \cdot Mg(O_2CCH_3)_2$	Magnesium Chloride $MgCl_2$	Calcium Chloride $CaCl_2$	Potassium Acetate KO_2CCH_3	Sodium Chloride (salt) Brine $NaCl_2$
COMMON FORM	Solid forms	Solid forms Liquid	Liquid Dry flake (mixed with other deicers)	Pellets Flakes Liquid	Liquid	Liquid
APPROXIMATE PURCHASE PRICE	$25-35/ton	$700/ton (solid) $1.25/gallon (liquid)	$.60/gallon or $65–95/ton (liquid) $263–366 ton (flake)	$260/ton (pellets) $200/ton (flakes) $.63/gallon (liquid)	$5.35/gallon	$.04/gallon
EUTECTIC TEMPERATURE*	-6° F	-13° F	-22° F	-57° F	-76° F	-6° F
USE	• wetted with CaCl • plain • wetted with NaCl brine	• CMA liquid mixed with salt or sand • liquid alone	• sprayed directly on road • mixed with sand or other deicers	• mixed with salt • used to prewet salt • straight/alone or in solution	• used as a prewetting agent for solids like salt, urea, sand, or CMA	• prewetting other chemicals • anti-icing
ADVANTAGES	• low purchase price	• less corrosive than salt • reduces corrosion on steel bridges	• attracts moisture from the air, which hastens dissolving and melting • does not require post-distribution cleanup • doesn't appear to contribute to air pollution	• releases heat when it dissolves • reduces the amount of salt used by 10–15% • attracts moisture so it helps snow melt	• requires fewer applications • may be used alone if needed • safer than salt for structural steel and reinforcing steel	• cost • little to no residue on pavement • doesn't draw moisture so doesn't leave road wet and slick
DISADVANTAGES	• can be corrosive to structure steel in bridges, and cars • potentially harmful to roadside vegetation • can contaminate surface water and drinking supplies	• use twice a as much CMA as salt • high concentrations can reduce oxygen levels in streams and lakes	• keeps pavement wet if it attracts too much moisture from the air • cost	• cost • keeps pavement wet	• cost	• corrosive to cars and bridges
NOTES	• workhorse of deicing chemicals	• best thing going from an environmental standpoint	• liquid used as an anti-icing agent when air temperatures exceed 10° F • can be applied to main streets and busy intersections before light snowstorms to melt snow as it hits pavement	• sprayed in approximately 32% solution for winter use • must be covered and kept in a dry place • can be used to prewet salt	• liquid works best as a deicer if applied in narrow bands	• used primarily as prewetting and/or anti-icing agent

* Eutectic, rather than effective, temperatures are listed. Actual effective temperatures vary widely depending on roadway and atmospheric conditions.

. . . WINTER!

Deicing chemicals

continued from page 8

ronment. However, there are few documented cases of severe environmental damage due to rock salt from roads. For environmental and cost reasons, maintenance crews are continually searching for ways to reduce salt waste. (See the article below on the zero-velocity spreader.)

Potassium acetate (PAC) and calcium magnesium acetate (CMA) are possible alternatives to salt. Both perform well at moderate to low temperatures (approximately 25° F for CMA, and below 0° F for PAC), and are noncorrosive to reinforcing steel in pavements, bridge structures, or cars. Iowa State University researchers have recently found, however, that CMA may damage concrete made with certain kinds of course dolomite aggregate (see the article on page 2). Cost is the main barrier to using these chemicals. PAC costs $5.35 per gallon and CMA costs $700 per ton for a 50 percent solution. Due to cost, these materials are used mainly in areas where salt is prohibited due to its corrosive effects or environmental concerns.

Iowa is currently using CMA as a deicing chemical on the bridge connecting Burlington, Iowa and Gulfport, Illinois. Fred Bartos, Southeast Iowa Transportation Center maintenance engineer, says CMA was chosen as a deicing agent because CMA does not corrode steel as salt does. This fact is important because the weight of the bridge is balanced equally among the bridge's steel deck and cables, which constitute the main support for the bridge. According to Bartos, the towers and cables would be extremely expensive to replace so the Iowa DOT is using every possible method to increase their longevity—including avoiding the use of corrosive rock salt. Another factor contributing to the decision to use CMA on the Burlington bridge is the fact that CMA is manufactured nearby.

For several years, FHWA researchers have been searching for less expensive methods of producing CMA and PAC. One possibility has been to introduce bacteria to waste products like old corn, solid municipal waste, sewage sludge, or cheese whey and then mixing the fermented product with potassium hydroxide or dolomitic lime. Studies have shown that this process produces CMA and PAC at a cost less than half the current commercial prices.

Another alternative to rock salt, calcium chloride, may also be rather costly at around $200/ton, but its benefits may offset its cost. Calcium chloride breaks the ice and bond quickly by giving off heat as it dissolves upon contact and remains effective when pavement temperature drops below zero degrees Fahrenheit. Calcium chloride absorbs moisture when exposed to air, so it must be kept indoors in a dry spot.

Bob Dingman, street maintenance crew chief for the City of West Des Moines, says he uses sodium chloride mixed with sand until the temperature drops below 20° F. He then uses calcium chloride to prewet the mixture because the calcium chloride will remain effective in temperatures below 20° F.

Rock salt and/or other chemicals—the choice can be critical, and it's yours.

Information in this article and the accompanying chart was collected from the following sources:

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Russell, Glen A. (Distinguished Professor, Iowa State University). Personal interview. August 2, 1995.
Snow Business: A Contractor's Guide to Profitable Snow Removal and Ice Control. Addison, IL: The Aberdeen Group, 1992.
Tordale, Diane (Chief of Purchasing Services Bureau, Montana Department of Transportation). Personal interview. August 2, 1995.
"What's new in deicing?" *Better Roads*, December 1994.

■

Iowa shop tries zero velocity spreader

By April Greenbeck
Editorial Assistant

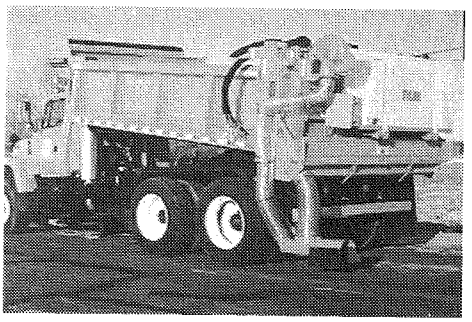
Iowa is a Federal Highway Administration test site for a new concept in roadway chemical spreaders: the zero velocity spreader.

The spreader lays material behind the rear wheel of the truck, projecting it in the opposite direction as the movement of the truck and at precisely the same speed as the truck, causing the material to land at a velocity that is zero relative to the road surface. The process prevents the material from bouncing when it hits the road, saving up to 40 percent in deicing material.

The deicing material is generally prewetted, which aids in reducing the amount of lost material, but dry chemicals can also be used.

The West Des Moines garage of the Iowa Department of Transportation is in its second year of testing the only two zero velocity spreaders in Iowa. Charles

continued on page 10



Zero velocity spreader

(Photo courtesy Tyler Industries)

Tips from the field

Two-section post system curtails sign vandalism, theft

Ed Bigelow, Iowa Transportation Center's Safety Circuit Rider, brings this tip from Muscatine County.

Traffic signs are vandalized everywhere in Iowa. About 18 months ago, Muscatine County switched to a square galvanized steel post system in high-vandalism areas, and signmen Wayne Martin and Doug Holiday are monitoring the county's savings with this system.

While not commonly used in Iowa for traffic signs, square galvanized steel posts are familiar to many Iowans. They have been widely used for 911 rural street signs in the last few years.

These signs have two-section posts made of galvanized steel. One section is driven into the ground, and another section slides into and is bolted to the ground section. When vandals knock the sign over, only the section above the ground is damaged.

Muscatine County is using a four-foot ground section for most traffic signs, a length that provides the necessary stability for traffic signs along county roads. This section can be reused, speeding the post replacement process and eliminating the need for calls to "Iowa One-Call" requesting the utility company to inspect and approve the post site each time they have to replace a sign.

The galvanized steel square posts cost about the same as wood posts. Martin and Holiday find that savings come from replacing posts more quickly and from buying fewer replacement posts. Also, fewer signs have been stolen, since signs are riveted to the galvanized metal posts.

So far Muscatine County is happy with the new sign system. If you have questions call Wayne Martin or Doug Holiday, 319/263-6351. ■

Muscatine County signmen Doug Holiday (left) and Wayne Martin show how they install the ground section of the square steel post system.

Zero velocity spreader *continued from page 9*

Pickett, highway maintenance supervisor there, says the new spreaders work well and waste less material than other spreaders he's used.

The garage uses a deicing mixture of 50 percent salt and 50 percent sand. As the spreader truck travels down the roadway, a three-percent salt brine solution is injected into the salt/sand mixture, which then falls through a chute in the zero velocity spreader. At the end of this chute, an air blower blows the mixture away from the truck at the same speed the truck is moving.

The chute can be moved from right to left from inside the cab, allowing more exact placement of the deicing material.

According to Pickett, "The zero velocity spreader is a very versatile piece of equipment that can be run on any system, two-lane or four-lane." To his knowledge this system saves material because the material stays on the pavement better. "The spreader has probably showed a 15 to 20 percent savings," he says.

Warren Barns, maintenance supervisor for the Minnesota Department of Transportation, has been using the spreader for three years. Barns says the spreader allows crews to spread the material at 35 to 40 miles per hour without leaving material along the side of the road. This is a definite improvement over conventional spreaders, which confine speed to between 15 and 20 miles per hour while leaving material on the side of the road. According to Barns the use of the spreader has resulted in a savings of 30 percent or more.

The spreader sells for approximately $10,900, compared to $2,000 to $2,500 for more common spreaders, but test sites have indicated that material savings compensate for the increased cost.

For more information on the zero-velocity spreader, contact Charlie Pickett, 515/225-3322. ■

FREE SHRP snow fence!

The Iowa Transportation Center has five 100-foot sections of snow fence available to a local government agency FREE for the asking. The basic design for this fence was developed by the Strategic Highway Research Program; these sections were produced by five different manufacturers.

Whoever receives the snow fence should be willing to

(1) install the five sections of snow fence consecutively along an approximately 600-foot stretch of road this winter and

(2) submit a simple, subjective report comparing the fences' installation, maintenance, and performance during the '95–'96 winter season.

In return, you can keep the fence!

For more information, call Duane Smith, associate director for outreach, 515/294-8103. ■

For more information

Following is a sampling of new or popular materials available from the Iowa Transportation Center library. To obtain materials or a catalog of materials, contact Stan Ring, library coordinator, Monday, Wednesday, and Friday mornings, 515/294-9481. Or use the order form below.

Publications

Lead-Containing Paint Removal, Containment, and Disposal U.S. DOT–FHWA–RD–94–100, 1995. This publication reports on the costs and problems of conforming to environmental and worker health and safety regulations. Various removal and containment methods are studied and evaluated. Loan copy. **Request #P1093.**

A Guide for Local Agency Pavement Managers Washington State DOT, 1994. Because of the federal mandate for a pavement management system, this manual was prepared for local agencies. It assists local agency pavement managers in understanding the process and steps necessary to implement their own PMS. Loan copy. **Request #P1097.**

Maintenance Practices for Local Roads Pennsylvania DOT, 1994. These four manuals were designed to aid municipalities in Pennsylvania administer, manage, and conduct road maintenance activities. Loan copies.
Request #P1099, Vol. I, Maintenance Techniques
Request #P1100, Vol. II, Personnel Supervision
Request #P1101, Vol. III, Program Administration
Request #P1102, Vol. IV, An Overview for Elected Officials

Seismic Retrofitting Manual for Highway Bridges U.S. DOT–FHWA–RD–94–052, 1995. This manual is an interim revision of a 1983 report. It describes an evaluation procedure for bridges and outlines methods to upgrade structures. Loan copy. **Request #P1108.**

SUPERPAVE Asphalt Mixture Design Illustrated U.S. DOT–FHWA–SA–95–004, 1995. This manual provides sequential, illustrated steps for performing SUPERPAVE test procedures on asphalt mixtures, level 1 design. It is also a self-contained laboratory reference document. Loan copy. **Request #P1106.**

Corrections to MUTCD Part VI

The library has received a special Federal Highway Administration publication, "Errata No. 1 for Part VI of the Manual on Uniform Traffic Control Devices (MUTCD) (November 1994)."

Copies have been sent to everyone who ordered Part VI, MUTCD through this office. For a copy of Errata No. 1, contact Stan Ring, 515/294-9481. ■

Videotapes

Testing and Field Inspection of Roadway Delineation (35:45 min.) U.S. DOT–FHWA. This videotape provides training on a field inspection program to evaluate pavement markings, highway signs, and roadway delineation systems. Loan copy. **Request #V385.**

Guidelines for Dust Control in Alabama (11 min.) Auburn University, 1994. This videotape supplements publication P1047 on the same subject. It illustrates dust control problems and covers the treatments. Loan copy. **Request #V384.**

Environmental Protection Issues. (15 min.) NCHRP–20–25(2). This videotape for construction inspectors explains the need for environmental concerns. It documents examples of pollution and archeological site damage during highway construction. Loan copy. **Request #V383.**

Project Documentation (9:44 min.) NCHRP. This videotape is for construction inspectors. It explains the importance of keeping clear, concise, correct, complete, and concurrent diary entries, and problems with inadequate documentation. Loan copy. **Request #V382.**

LTAP News CD: an electronic file cabinet

Michigan's Local Technical Assistance Program has electronically archived newsletters and technical bulletins published in 1993 by LTAP centers across the country. The compact disk archive, *LTAP News 1993*, is available free from the Iowa Transportation Center. (Disks for 1992 and 1994 will be available soon.)

In *LTAP News*, you will find transportation-related research and tips from every state. The CD contains text files of all relevant articles, along with graphic images of every page. Its search capabilities are not limited to general keywords but can find all words in the text files. You can also search by state, by publication, and by issue. Text files can be exported to other software, and images can be printed on common 300 dpi laser printers.

No extra software is required. All you need is a PC running Windows 3.1 or newer and a CD-ROM.

To get your own *LTAP News 1993* CD, contact Stan Ring, 515/294-9481. ■

Library order form

To obtain materials from the ITC library, return this form to the Iowa Transportation Center, Iowa State University, 2521 Elwood Drive, Suite 125, Ames, Iowa 50010-8263. (Please limit your request to four items. Thank you.)

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Conference calendar

20th Anniversary Meeting-Iowa Traffic Control Safety Association (ITCSA) Fall Conference September 14–15—Carroll This conference is designed to promote safe and efficient transportation on the streets and highways of Iowa. It is also a forum to address mutual concerns about achieving this goal through education, enforcement, and engineering, as well as emergency medical services. Contact Don Wall, 515/294-3811.

American Society of Civil Engineers (ASCE) Iowa Section Annual Meeting September 14–16—Ames This conference includes technical sessions regarding the latest technologies that can improve design and construction activities for bridges, roads, and structures. Speakers include Dr. James Melsa, the new Dean of ISU's College of Engineering. Contact Jim Cable, 515/294-2862.

American Public Works Association (APWA) International Public Works Congress and Exposition September 23–28—Dallas, Texas This conference allows public works professionals the opportunity to look into the industry's future and learn about the latest technological innovations and advances in the field. Contact Duane Smith, 515/294-8103.

APWA Snow Roadeo October 3–4—Des Moines This "roadeo" provides equipment operators a chance to sharpen their skills before snow-clearing season begins. It consists of a written test, a timed search for vehicle safety defects, and a driving simulation course with situations drivers might encounter while clearing the streets. New features this year include a two-day schedule, a backhoe/loader proficiency exhibition and a "share your expertise" segment where individuals can discuss the latest techniques. A tandem class also joins the single axle class. Contact Bret Hodne, 515/222-3480.

Rural Public: Intercity Bus Transportation October 22–25—Des Moines This conference, designed for transportation providers, will focus on new technology, FTA regulations, and innovative approaches for use of intercity assistance funds. Contact Duane Smith, 515/294-8103.

Video for Traffic Management October 30–31—Ames This seminar incorporates the latest in technology by using video to evaluate traffic flow. The video allows transportation workers to study the speed of the vehicle, vehicle occupancy, classification, and the queue length at signalized intersections. Contact Duane Smith, 515/294-8103.

Better Concrete Conference November 2—Ames This conference focuses on the latest information dealing with both transportation-related and vertical construction. Contact Jim Cable, 515/294-2862.

First Iowa Geographic Information Systems (GIS) Conference November 7–8—Iowa City This conference lays the foundation for formal GIS activity in Iowa. Speakers will discuss a variety of topics including large-scale basemapping, information on GIS technologies, emergency management systems, transportation, and communications. Contact Reg Souleyrette, 515/294-8103.

ASCE Transportation Conference November 8—Ames This conference deals with various elements of transportation, including specifications and construction. Contact Don Wall, 515/294-3811.

Maintaining Pavement Performance into the Future November 7 and 9—Council Bluffs and Atlantic City and county engineers, along with consulting engineering staff, will learn how to solve pavement maintenance problems, maintain pavement surface, and understand the principles of patching with asphalt or concrete products. Contact Sharon Prochnow, 515/294-8103.

ASCE Structural Design Conference November 13—Ames This conference includes discussions and presentations regarding structural design and transportation design. Contact Don Wall, 515/294-3811.

Iowa County Engineers Annual Conference December 5–7—Ames This conference offers county engineers and their staff the latest in county engineering operations techniques. Contact Jim Cable, 515/294-2862.

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